PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

SCREENING RESULTS FOR CENTENNIAL BUILDING

Admin Minnesota
DEPARTMENT OF ADMINISTRATION

November 29, 2010

Summary Table

Centennial Building	
Location	658 Cedar Street St. Paul, MN 55155
Facility Manager	Gene Peterman
Number of Buildings	1 and Parking Garage
Interior Square Footage	312,079
Parking Ramp Square Footage	492,000 (approximate)
PBEEEP Provider	Center for Energy and Environment (CEE) (Neal Ray)
State's Project Manager	Pat Ferrin
Date Visited	11/8/2010
Annual Energy Cost	$985,600 (Source: B3; 2009)
Utility Company	District Energy St. Paul (Hot and Chilled Water), Xcel Energy (Natural Gas and Electricity)
Site Energy Use Index (EUI)	152.9 kBtu/ft^2
Benchmark EUI (from B3)	*114 kBtu/ft^2

*The Benchmark EUI was revised based on observations from the screening phase to include a Data Center. The Benchmark EUI changed from ~ 102kBtu/ft^2 to114 kBtu/ft^2.

Screening Overview

The goal of screening is to select buildings where an in-depth energy investigation can be performed to identify energy savings opportunities that will generate savings with a relatively short (1 to 5 years) and certain payback. The partial screening of Centennial Building was performed by Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on November 8, 2010 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and their potential for recommissioning. This report is the result of that information.

Future Candidate for Investigation

Investigation of the Centennial building is not recommended at this time due to a ventilation study that is in process at the site and anticipated HVAC system changes. The current project is expected to result in major HVAC system re-design. This was discussed in follow up with Dept. of Administration staff and the project contractor, EEA. The PBEEEP approach is to comprehensively evaluate energy consuming equipment and systems to identify ways to optimize operations through recommissioning. The project would require the ability to baseline on current, stable energy use and operations and with the planned study and the expected plans for HVAC system re-design, a PBEEEP project could not be completed at this time. Additionally, due to the procurement process used for the study contract, the existing contract cannot be amended to integrate into a PBEEEP project.

The Centennial building may be a good candidate for investigation following the completion of the current ventilation project and pending a re-assessment of building performance at that time.

It has a large square footage, several large air handling units, a lot of the buildings' equipment is automated; and the building has not been known to have been commissioned. In addition, the parking garage, indicated potential for savings. A summary of that screening can be found at the end of this report. CEE recommends the PBEEEP project be closed out at this time and for the building to be re-evaluated following the close of the current project and once a full year of stable energy usage performance can be established.

Building Name	State ID	Area (Square Feet)	Year Built	Recommended for Investigation
Centennial Building	G0231010762	312,079	1958	N
Centennial Parking Garage		492,000		Y (separate project)

While completing screening at the Centennial Building, Center for Energy and Environment (PBEEEP) staff discovered that the building had an HVAC project in process. The following pages of this report were generated through the partial screening conducted at the site.

Centennial Building Screening Overview

This screening report is based on the PBEEEP Guidelines. It is based on two site visits, review of the facility documentation, building automation system, a limited inspection of the facility and interviews with the staff. The purpose of the screening report is to evaluate the potential of the facility for the implementation of cost-effective energy efficiency savings through recommissioning. To the best of our knowledge the information here is accurate. It provides a high level view of many of the important parameters of the mechanical equipment in the facility. Because it is the result of a limited audit survey of the facility, it may not be completely accurate or inclusive.

The Centennial Building is one building totaling 312,079 ft^2 on the State Capitol Complex. It was constructed in 1958 and there have been several mechanical upgrades during the history of the building. The building is comprised of administrative space with a data center on the fifth floor. The building has an attached, 5 level parking ramp totaling approximately 492,000 ft^2 with some servicing mechanical equipment that should be included in an investigation energy study.

Mechanical Overview

The building receives hot water from St. Paul District Energy. There is a heat exchanger in the south mechanical room which transfers energy from the district hot water to the building hot water system. The hot water is then distributed to the induction and reheat system. Chilled water is supplied to the building from the State Capitol Complex chilled water loop distribution system.

There are a total of 11 AHUs on the automation system. Seven of the AHUs have supply fans which are 15 HP or greater. Two of the units, S-3 and S-9 are divided up into two separate units on the automation system (S-3a, S-3b, S-9a, S-9b), but are one unit.

There are also north and south mixing air stations which mix the outdoor air and return air for nine of the AHUs. The units return air from each of the five floors and air is exhausted out through two large relief fans on the north and south sides of the building. The AHU supply fans modulate their speed with respect to the relief fans to assure the space pressure is positive on each floor.

The building is heated around the perimeter of each floor with floor mounted induction units that contain coils which utilize either hot or cold water depending if it is heating or cooling season.

Controls and Trending

The building is controlled by the State Capitol Complex Honeywell EBI automation system. It is operated by the Plant Management Division (PMD) of the Department of Administration. PMD controls the building automation system. The system is fully capable of trending. PMD will set up all trending required for the project based on the direction of the provider. The data will be exported in a standard format such as CSV. A total of 24,000 points can be trended on the automation system. The automation system also serves all the buildings on the State Capitol Complex. There would be 2,000 to 4,000 available points to trend at each building.

Lighting

Most of the interior lighting consists of T8 32 Watt lights. These lights are mainly controlled by switches. There are very few occupancy sensors or timers controlling interior lights. Outside lights are controlled by the automation system. The facility recently had a lighting study performed which includes energy saving recommendations; this study will be a source of measures to be considered for implementation under PBEEEP once the project proceeds.

EUI B3 Benchmark Overview

As found in the B3 system, the actual energy user index (EUI), as computed from utility bills and square footage, was at 153 kBtu/ft^2, which was significantly more than the B3 benchmark score of 103 kBtu/ft^2. The benchmark value was found to be lower than it should be as a result of space usage selections in the B3 system. Site visits show there is a data center which occupies an estimated one-third of the 5^{th} floor, was not being factored into the benchmark. Once this was updated in B3, the benchmark was adjusted to 114 kBTU/ ft^2. The median site EUI for State of Minnesota buildings are 23% lower than their corresponding B3 Benchmarks. Often, buildings that meet their benchmarks have opportunities to lower their energy use through recommissioning.

Metering

The exact number of electrical meters was not yet determined. If the building is to go forward with an investigation in the future the exact number of electrical meters will be determined at that time. There is one chilled water meter and one hot water meter.

Documentation
The availability of documentation within the building was found to be limited. This is primarily due to the age of the building. As-builts were difficult to locate on mechanical equipment within the building. Electronic copies of some of the building plans are available.

Centennial Parking Garage Comments
There are five levels all of which are partially or completely open to the outdoors. Since the ramp is open to the outdoors it is not heated or cooled. The operating schedule of the parking ramp is from 6 AM to 12 AM Monday through Friday with some weekend hours. The two exhaust fans within the ramp which are 15 and 25 hp run 24/7 year around. There are also 401 existing High Pressure Sodium (HPS) light fixtures with the parking ramp. The lighting in the ramp is being addressed in a separate PBEEEP project.

Mechanical Equipment Summary Table	
1	Building Automation System
312,079	Square Feet of for Centennial Building
492,000	Square Feet of parking garage space
11	Air Handlers (one not used)
2	Hot water to hot water heat exchangers
17	Dry Coolers
19	CRAC units
6	Pumps associated with CRAC units and dry coolers
5	Heat pumps
4	Induction pumps (2 for CHW and 2 for HW)
4	Pumps (2 for CHW and 2 for HW)
2	Large Exhaust fans in the parking garage
401	High Pressure Sodium (HPS) fixtures in the parking garage
300	Points for trending (estimated)

Building Summary Tables
The following tables are based on information gathered from interviews with facility staff, a building walk-through, automation system screen-captures, and equipment documentation. The purpose of the tables is to provide the size and quantity of equipment and the level of control present in each building. They are complete and accurate to the best of our knowledge.

Centennial Building				State ID# G0231010762	
Area (sqft)	312,079	Year Built	1958	Occupancy (hrs/yr)	4,368 (per B3)

HVAC Equipment

Description	Type	Size	Notes
Fan S-1	Variable air volume`	Fan 1A: 40 HP Fan 1B: 40 HP Total of 46,800 CFM	2 Supply Fans. VFD on Fan 1A is currently not working.
Fan S-2		Fan 2A: 40 HP Fan 2B: 40 HP Total of 46,800 CFM	2 Supply Fans
Fan S-3a	Constant Volume	20 HP	
Fan S-3b	Constant Volume	15 HP	
Fan S-4	Multi-Zone	24,500 CFM 30 HP SF	SF has VFD. Installed in 2006
Fan S-5	Constant Volume		
Fan S-6	Constant Volume		Not used, automation only contains a fan status point
Fan S-7	Constant Volume	Fan 7A: 50 HP Fan 7B: 50 HP Total of 52,200 CFM	2 Supply Fans. VFD on Fan 7A is currently not working.
Fan S-8	Constant Volume	Fan 8A: 50 HP Fan 8B: 50 HP Total of 52,200 CFM	2 Supply Fans. VFD on Fan 8A is currently not working
Fan S-9a	Constant Volume	10,190 CFM 25 HP	
Fan S-9b	Constant Volume	7,425 CFM 20 HP	
Fan S-17	Constant Volume	5,300 CFM	Installed in 1992
Fan S-18	Constant Volume	1,600 CFM	Installed in 1992
Heat Exchanger 1			
Domestic Heat Exchanger 2			
Glycol Pump #3	Constant Volume	3 HP	Associated with the Centennial glycol system
HW Pump #4	Constant Volume	1 HP	Associated with the Domestic HW system
HW Pump #5	Constant Volume	5 HP	Associated with hot water being served to the loading dock

HVAC Equipment (cont)

Description	Type	Size	Notes
CHW Pump #6a	VFD	15 HP 710 gpm	Design documentation states this pumps should be 20 HP
CHW Pump #6b	VFD	15 HP 710 gpm	Design documentation states this pumps should be 20 HP
Reheat Pump #1A	Constant Volume	10 HP 500 gpm	
Reheat Pump #1B	Constant Volume	10 HP 500 gpm	
Induction Pump #2A	Constant Volume	176 gpm 10 HP	
Induction Pump #2B	Constant Volume	650 gpm 30 HP	
RF-1	VFD	70,000 CFM 50 HP	Relief air for the North side of building
RF-2	VFD	70,000 CFM 50 HP	Relief air for the South side of building
14 VAV boxes	Fan powered VAV boxes	200 to 930 CFM	On the fourth floor installed in 2003
17 Dry Coolers		Unknown design conditions	
19 CRAC Units			
P10, P-11		20 Hp each	Associated with units AC-17, AC-18, AC-19
P-5, P-6		15 HP	Associated with u nits AC-1, AC-2, AC-3, AC-21
P-3, P-4		20 HP	Associated with units AC-3, AC-4, AC-5, AC-7, AC-9, AC-11, AC-22
5 Heat Pumps	Heat Pumps	800 to 2,400 CFM	Associated with Dry cooler 21
HU-1	Humidifier	24 lbs/hour	
2 Large Exhaust Fans	Constant Volume	15 HP and 25 HP	Serves the parking garage

Points on BAS

Description	Points
Fan S-1 Fan S-2 Fan S-7 Fan S-8	MAT, CHW valve %, Humidifier valve %, Fan status, Fan speed, Damper command, Duct static setpoint, Duct static, DAT, DAT setpoint, DA humidity, DA humidity setpoint
Fan S-3a Fan S-3b Fan S-9a Fan S-9b	CHW valve %, Fan status, DAT, DAT setpoint
Fan S-4	OA damper %, MAT, MAT setpoint, Fan status, Fan speed, High limit fan speed, Low limit fan speed, DAT, DAT setpoint, High limit DAT setpoint, Low limit DAT setpoint, Duct static, Duct static setpoint, Zone damper %, Zone temperature, Zone temperature setpoint, RAT, Economizer enable setpoint
Fan S-5	OA damper %, CHW valve %, Fan status, DAT, DAT setpoint, Economizer enable setpoint
Fan S-17 Fan S-18	HW valve %, Fan status, DAT, DAT setpoint
EF-3 EF-17 EF-18	Fan status
Mixed air section	RARH, High limit RARH, Low limit RARH, RAT, OA damper %, Economizer enable setpoint, DAT, DAT setpoint
Static pressure control section	Floor damper %, Floor static, Floor static setpoint, Relief fan damper, Relief fan damper command, Fan speed, Fan command, Duct static, Duct static setpoint, EA humidity %, EAT
Chilled Water System	CHWST, CHWS valve %, CHWR valve%, Pump command, Pump status, Pump speed, CHWRT, CHWRT setpoint, North mechanical CWR flow, South Mechanical CWR flow, Differential pressure, Differential pressure setpoint, OA valve enable temperature, OA pumps enable temperature
Induction Water System	Induction supply temperature, Induction supply temperature setpoint, Induction pump command, Induction pump status, Induction valve %, OA pumps enable temperature
Hot Water System	Building HWST, Building HWST setpoint, Building HWRT, Reheat pump command, Reheat pump status, Pump OAT enable setpoint, Induction pump command, Induction pump status, District HWRT, HX valve %, HW low limit reset setpoint, HW high limit reset setpoint
Glycol Hot Water System	Building HWRT, Building HWST, Building HWST setpoint, HX valve %, Pump status, Pump OAT enable setpoint, HW low limit reset setpoint, HW high limit reset setpoint
Domestic Hot Water System	Building domestic HWST, Building domestic HWST setpoint, Domestic HWP status, HX valve %
Lighting System	Exterior lights command

Additional Comments
• Units S-3a, S-3b, S-4, S-9a, and S-9b were balanced in 2007 • Induction units are not on the automation system • An estimated 30% of the fifth floor is data center, majority of the equipment is not on the building automation system. • Due to the current construction within the facility an energy investigation is currently not recommended.

Customer comments obtained in the screening process

The following information was provided following the site visit by Pat Ferrin of Real Estate and Construction Services regarding problems with existing Induction Units located on the outside walls and general information on District Energy:

- High pressure air is induced across a venturi which doubles the air flow into the space. Although there are thermostats, it is unknown if each unit has a thermostat. The zone setup for the units is also not fully known. The building has pneumatic VAV boxes and some of these could be connected to exterior wall Induction Units.
- A second problem with the Induction Unit is that there is a drain pan below each one however no drain connection. The chilled water temperature has to be maintained at approximately 60˚ F or warmer to prevent cooling coil condensation. One recommendation for further review is to insulate the drain pans and connect drain piping to drain away condensate.
- District Energy has a two part billing demand and energy. Demand is approximately 70% of the bill and energy use is only 30% of the bill. It was thought that after approximately two years of service the demand energy would be fixed for the contract term of 20-30 years.
- Degree days are measured for both heating and cooling. A multiplier is used, for example when winter weather is warmer than usual, that inflates the energy consumption from actual to an adjusted amount.

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HP	Horsepower
BAS	Building Automation System	HRU	Heat Recovery Unit
CD	Cold Deck	HW	Hot Water
CDW	Condenser Water	HWDP	Hot Water Differential Pressure
CDWRT	Condenser Water Return Temperature	HWP	Hot Water Pump
CDWST	Condenser Water Supply Temperature	HWRT	Hot Water Return Temperature
CFM	Cubic Feet per Minute	HWST	Hot Water Supply Temperature
CHW	Chilled Water	HX	Heat Exchanger
CHWRT	Chilled Water Return Temperature	kW	Kilowatt
CHWDP	Chilled Water Differential Pressure	kWh	Kilowatt-hour
CHWP	Chilled Water Pump	MA	Mixed Air
CHWST	Chilled Water Supply Temperature	MA Enth	Mixed Air Enthalpy
CRAC	Computer Room Air Conditioner	MARH	Mixed Air Relative Humidity
CV	Constant Volume	MAT	Mixed Air Temperature
DA	Discharge Air	MAU	Make-up Air Unit
DA Enth	Discharge Air Enthalpy	OA	Outside Air
DARH	Discharge Air Relative Humidity	OA Enth	Outside Air Enthalpy
DAT	Discharge Air Temperature	OARH	Outside Air Relative Humidity
DDC	Direct Digital Control	OAT	Outside Air Temperature
DP	Differential Pressure	Occ	Occupied
DSP	Duct Static Pressure	PTAC	Packaged Terminal Air Conditioner
DX	Direct Expansion	RA	Return Air
EA	Exhaust Air	RA Enth	Return Air Enthalpy
EAT	Exhaust Air Temperature	RARH	Return Air Relative Humidity
Econ	Economizer	RAT	Return Air Temperature
EF	Exhaust Fan	RF	Return Fan
Enth	Enthalpy	RH	Relative Humidity
ERU	Energy Recovery Unit	RTU	Rooftop Unit
FCU	Fan Coil Unit	SF	Supply Fan
FPVAV	Fan Powered VAV	Unocc	Unoccupied
FTR	Fin Tube Radiation	VAV	Variable Air Volume
GPM	Gallons per Minute	VFD	Variable Frequency Drive
HD	Hot Deck	VIGV	Variable Inlet Guide Vanes

Conversions
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH